

but we are rather sorry to find the authoress enthusiastic at the passing of the "Injurious Insects" Act of Parliament, which we prefer to consider the outcome of a scare furthered by speculators. All we can say for the "Introduction to Entomology" is that it will possibly serve to give the class for whom it is intended sounder ideas on the subject than generally prevail with them; the Glossary at the end is too short to be of much service.

Zinn: eine geologisch-montanistisch-historische Monographie. Von E. Reyer. 8vo. (Berlin: Reimer, 1881.)

IN this monograph, as is indicated by the agglutinative adjective on the title-page, the author has collected the results of his studies on the technological history of the metal tin under the threefold head of geology, mining, and history; or rather the reader may do so for himself from the material which is presented in an abrupt fashion without either preface or index. The first part of the volume is devoted to descriptions of the tin-producing districts of Saxony and Bohemia, the geological features of each district being first considered, then its history as derived from the local archives and notices in published chronicles, the whole of the facts concerning production being summed up in a chronicle of tin mining in Bohemia and Saxony, with tabular statements and diagrams of the production from the earliest period for which records are obtainable, about the year 1400, down to the present time. From these we gather that the total production of both countries, which was about 100 tons in the year 1400, reached in 1500 a maximum of about 1000 tons, since which time it has steadily declined, the produce at intervals of fifty years varying from 75 to 125 tons annually. At the present time the production is practically confined to Altenberg in Saxony, where about 50 tons are obtained from the treatment of a stamiferous granite containing about 8 lbs. of tin ore per ton. In subsequent sections of the volume the productions of Cornwall, Banca, and Australia are treated in a similar manner; a descriptive sketch of the geology of each locality being given in each case, followed by a chronicle of events and prices. These being mainly compiled from well-known sources, such as De la Bêche's "Cornwall and Devon," Von Diest's "Banca," the reports issued by the Australian and Tasmanian Colonial Governments, &c., present less of novelty than the first part, which contains much original matter derived from the author's own investigations; but the skillful manner in which the information is presented is likely to render the volume very useful to those interested in the subject. An unnecessary difficulty has been introduced by the adoption of the new-fashioned phonetic system of spelling which has latterly become prevalent in Berlin, and will doubtless prove a puzzle to many readers.

H. B.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Progress of Meteor-spectroscopy

IN the profound and eloquent review of the progress of British and other discoveries in science during the last half century given in the Opening Address to the British Association at its recent Jubilee Meeting in York by its President, Sir John Lubbock, I am credited (*NATURE*, vol. xxiv. p. 409) with some meteor-spectrum observations which, while they certainly unfold some of the most important results arrived at in meteor-spectroscopy since its commencement in the year 1866, yet owe their recognition as scientific discoveries of some material weight and real consequence, to quite a different author.

Although with the first use of a meteor-spectroscope I recognised in the persistent streaks of the August Perseids of that year numerous examples of the yellow-sodium line, yet no proof was furnished by the slender spectroscopic power employed, of the existence in the meteor-streaks of any other substance. It was by a Hungarian astronomer, von Konkoly, that the presence of "lithium, potassium, and other substances" in the streaks of shooting-stars was afterwards discovered; and of some of these substances Herr von Konkoly obtained such repeated and well-verified observations, that the identification of their spectroscopic presence in certain meteor-streaks may be regarded as satisfactorily established.

The instruments made by Mr. Browning for the British Association Meteor-Committee in the year just mentioned were intended to be used in studying the spectra of the November Leonids, whose magnificent display took place as expected, but was of such short duration that nothing of great importance was, unfortunately, elicited as regards their spectra. A more successful trial of the instruments had however been made previously on the 9th-11th of August of the same year,¹ and abundant evidence was then obtained of the existence of two classes of meteor-streaks, both equally persistent, one of them affording a continuous spectrum only, like what hot sparks or train-matter would produce; the other more or less charged with, and sometimes consisting entirely of the yellow sodium-line.

No distinct evidence was obtained, however, in that first year's experimental trials of the occurrence in meteor-streaks of any other elementary spectrum-lines besides the solitary sodium one. The spectra of the nuclei were continuous, the brightest ones showing all the prismatic colours in perfection; and only one or two at the same time allowed some traceable evidence of sodium to be detected in their light. But a few of the green "Leonid" streaks were noticed in November to be, to all appearance, monochromatic, or quite undispersed by vision through the refracting prisms; from which we may at least very probably infer (by later discoveries with the meteor-spectroscope) that the prominent green line of magnesium forms the principal constituent element of their greenish light.

Meteor-spectroscopes of a more efficient kind were afterwards devised and produced by Mr. Browning. But they remained, as far as I am aware, without any successful application until the nights of July 25th and 26, 1873, when the spectra of three streak-leaving shooting-stars were observed through one of them by the enthusiastic astronomer of O'Gyalla, near Komorn in Hungary, Herr von Konkoly.² The streaks of the first two meteors seen showed only the sodium-line; but in that of the third, which was an emerald-green meteor, the green spectral line of magnesium (Fraunhofer's solar line *b*) was plainly visible in addition to the yellow sodium-line. The spectra of the nuclei were continuous, only the green region of the spectrum in that of the last meteor being of unusual brightness.

On the morning of the 13th of October in the same year Herr von Konkoly again observed with Browning's meteor-spectroscope the long-enduring streak of a large fireball, which was visible in the north-east at O'Gyalla. It exhibited the yellow sodium-line and the green line of magnesium very finely, besides other spectral lines in the red and green. Examining these latter lines closely with a star-spectroscope attached to an equatorial telescope, Herr von Konkoly succeeded in identifying them by direct comparison with the lines in an electric Geissler-tube of marsh-gas.³ They were visible in the star-spectroscope for eleven minutes; after which the sodium and magnesium lines still continued to be very brightly observable through the meteor-spectroscope; and the streak faded out of sight in a comet-seeker, at last, twenty-five minutes after it was first observed.

In July and August, 1879,⁴ and in August, 1880,⁵ Herr von Konkoly observed spectra of the nuclei and streaks of many Perseids and other meteors with the Browning's meteor-spectroscope. The yellow sodium-line was conspicuous in most of the streak-spectra, and adjoining it there were seen in many cases the red line of lithium and another more distant red line supposed to be that of potassium; but the violet line of potassium,

¹ *The Intellectual Observer*, vol. x. pp. 38 and (with a coloured plate) 61; August and October, 1866.

² *Monthly Notices of the Royal Astronomical Society*, vol. xxxiii. (1872-73), p. 575.

³ *Monthly Notices of the Royal Astronomical Society*, vol. xxxiv. (1873-74), p. 82. The description "lightning-gas" there given of the tube is, as Herr von Konkoly afterwards informed me, a misprint for "lighting," or "coal-gas," "mit welchem die Strassen beleuchtet sind."

⁴ *The Observatory*, vol. iii. p. 157.

⁵ *Ibid.*, p. 577.

probably owing to its relative weakness in comparison with the red one, could not be observed. Green and blue lines of other elements were also noticed, among which the most frequently conspicuous one, next to the yellow sodium-line, was, again, the green line of magnesium.

On August 13, 1879, the nucleus of an emerald-green bolide, as bright as Jupiter, produced a splendid continuous spectrum from red to violet, exhibiting first a bright sodium-line, and immediately afterwards the green magnesium-line also, and some others, supposed to be those of copper, with two faint red lines. A similar bolide on August 9, 1880, showed on the continuous spectrum of its nucleus, besides the sodium-line very bright, those of lithium distinctly, and many metallic lines in the green and blue portions of the spectrum.

This occurrence of carbon, magnesium, and other spectral lines (possibly of iron) in the vapour-streaks of shooting-stars and fireballs, establishes a more certain and unequivocal resemblance between their chemical compositions and those of solid meteorites, than does the exhibition of the sodium-line, which, as Herr von Konkoly observes, may possibly be due to the original presence of saline particles in the air itself. But its extreme brightness in some, and total absence in other meteor-streaks, seems yet rather difficult to account for on that supposition. On the other hand the detection of carbon, while it agrees with the element's occurrence in siderites and carbonaceous aërolites, reminds us also of the abundant proofs which Dr. Huggins and other spectroscopic observers have obtained of the same element's prevalence in comets. And indeed the prolonged luminosity of meteor-streaks, with their complex gaseous spectra proceeding for long courses of time from an exceedingly attenuated atmosphere, is itself a physical riddle whose explanation as a mere question of radiation can scarcely be very different from what is demanded by the phenomenon of self-luminosity in the known gaseous nebulae and in the envelopes of comets.

Of Dr. Huggins' applications of sidereal spectroscopy to nebulæ and comets, it may be mentioned that the extremely eventful discoveries are not individually named and noticed among the many high encomiums rightly bestowed upon that refined use of the spectroscope, in the opening address. But the results therefrom obtained were yet fully as revolutionising as regards the prevailing theories of those bodies, and of the general plan of construction of the sidereal heavens, as some of the spectroscopic discoveries described in the fifty-years' retrospect were (as is there lucidly related) thoroughly subversive of the formerly existing views of the internal physical condition of the sun.

If I have here ventured to disown, and to disclaim for myself some of the major accomplishments of meteor-spectroscopy by showing them to be the results of later, independent, and much more perfect observations, it is because, in comparison with the very significant amplification which those later observations have effected in the subject, the easy recognition of the presence of sodium in meteor-streaks can only claim to be regarded as a slight and inconsiderable first-adventure in a province of spectrum analysis, the additions and improvements subsequently made in which have been attended with much more remarkable success.

In the wide and accurate survey of the admirable opening discourse, which strays with truly lifelike fidelity over all the broad domains, the well-won fields and gallantly-scaled citadels of modern scientific knowledge, I shall, I trust, be pardoned if, in a matter of very little estimation by itself, I thus attempt to remove and banish from the eulogies of the address a small and unobtrusive and apparently unconscious excrescence of the otherwise harmless and innocent transgression, *magis componere parva*.

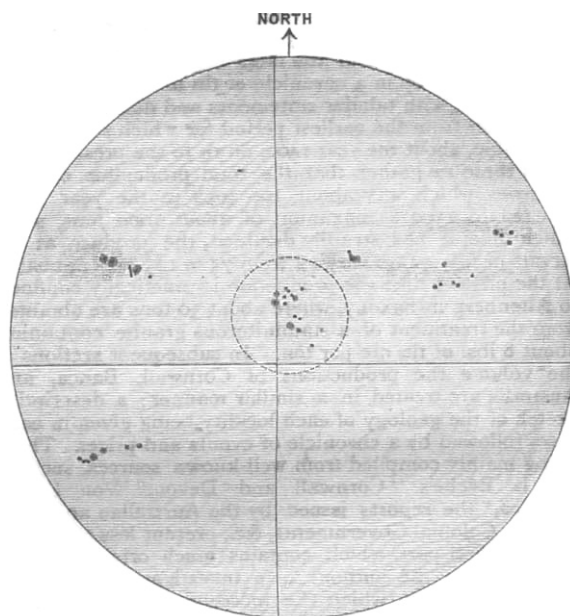
A. S. HERSCHEL

Collingwood, September 12

Sun-Spots

RECORDS concerning phenomena are considerably enhanced in value if they include accurate determinations of the times of occurrence. This appears specially applicable to solar phenomena, and particularly to sun-spots, of which there must be many thousands of exact delineations without precise record of the times when the spots first appeared on the visible surface of the sun. No doubt there are several reasons to account for this unavoidable absence of valuable information; amongst others the intense brightness and heat of the sun make it an exceedingly

disagreeable object for protracted telescopic inspection; nor yet are we in a position at present to photograph it continuously, so that we are necessarily content to compare photographs taken at intervals of perhaps many hours, and to assume, or at any rate not to dispute, that events of great importance have not occurred in the intervals. This is the more to be regretted because a knowledge of solar events is comparatively of little importance unless it helps us to ascertain what influence those events exercise on the earth and its inhabitants; and it is obvious that in comparing solar and terrestrial phenomena the times of occurrences are of essential importance, if only to avoid ascribing an undue effect to a given cause. It thus follows that even an approximate time of the appearance of sun-spots is not without value. On these grounds, as well as on the score of magnitude, I communicate the following particulars of a recent appearance, or outburst, of sun-spots, which occurred within certain moderate limits of time. I premise briefly that a photoheliograph is in daily use at the Trigonometrical Survey Office, Dehra Doon, India, of which I have executive charge. At present the instrument yields but a 4-inch negative, which is merely a microscopic delineation of 1¼ million millions square miles of solar surface; however, as surely



Tracing from sun negative taken at Dehra Observatory, Great Trigonometrical Survey of India. Latitude $30^{\circ} 19' 29''$ N.; Longitude $78^{\circ} 5' 42''$ E. Height above sea 2232 feet, on July 25, 1881, at 4.47 p.m. local apparent time. Spots visible in previous negative taken on the same day at 3.58 p.m. are coloured black; and the new spots which appeared between 4 and 5 p.m. are surrounded by a dotted circle.

as the sun shines, so surely are at least two negatives taken of it daily. Interruptions, even in a land of sunshine like this, sometimes occur; notably at the bursting of the monsoons, which occurred here last month (July), when the photographer was compelled to take the sun whenever visible, rather than not take him at all. Under this choice of alternations the first negative (or say N_1) on July 25, 1881, was taken at 3.58 p.m. of local apparent time; it exhibited several sun-spots, as is now usual, and of which therefore little need be said, since solar observers are well aware that the sun has for some months past resumed a state of considerable energy in respect to development of features; the second negative, or N_2 , was taken at 4.47 p.m. On comparing N_1 and N_2 it was at once seen that in the interval of 49m. a considerable group of spots had appeared in the neighbourhood of the sun's centre. It is exceedingly difficult to exhibit an exact delineation of spots when the negative is on so minute a scale; I however inclose a silver print, as well as a hand-tracing of N_2 , from which the position and magnitude of the group, *i.e.* the new group, may be nearly inferred. This new group consists of sixteen spots, of which no individual spot is notably large, but there is this peculiarity about them all, that they exhibit hardly any penumbra, but consist almost entirely of well-defined umbra; what penumbra appears, is